



FACT SHEET

UNITED STATES AIR FORCE

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YAL-1A ATTACK LASER



One of the United States Air Force's highest priority programs involves putting a weapons class laser aboard a modified Boeing 747-400 series freighter aircraft and using that laser to destroy theater ballistic missiles shortly after being launched. The program is called the Airborne Laser and the aircraft is designated the YAL-1A Attack Laser.

Destroying Scud-like missiles such as those used in the Gulf War is not a simple feat. The laser must be powerful enough to extend hundreds of miles away to destroy missiles that could be traveling two-thirds of a mile per second. Sophisticated sensors and optics must spot the missile shortly after launch and direct the laser, keeping it focused on its fast-moving target. Corrections must be made for the atmosphere, which typically distorts and spreads a laser beam. All these obstacles are being overcome.

The program has completed a wide variety of milestones, including the construction and roll-out of the first aircraft in December 1999 and its flight to Wichita, Kansas, in January 2000 for modifications and the installation of equipment that will turn it into a prototype weapon system. Modifications are expected to be completed in the spring of 2001 when the aircraft will transfer to Edwards Air Force Base, California, for testing. Testing will culminate in 2003 with the destruction of several theater ballistic missiles under simulated wartime conditions off the California coast. A seven-plane operational fleet could exist as early as 2009.

Responsible for producing the YAL-1A is the Airborne Laser System Program Office, formed in 1993 at Kirtland Air Force Base, New Mexico. The program office is a major unit of the Air Force Space and Missile Systems Center, headquartered at Los Angeles Air Force Base California.

Instrumental in producing the YAL-1A are several key contractors who are working under a \$1.3 billion contract. The initial cost-plus contract was awarded by the Air Force in November 1996 to Boeing Defense Group of Seattle, Washington. Boeing was to build the aircraft, manage systems integration, aircraft modifications, and the development of battle management systems (computers and software coupled to communications, intelligence and weapons-related instrumentation to detect, engage and defeat the attacking missiles).

Working with Boeing are two other contractors: TRW Space and Electronics Group of Redondo Beach, California, is developing the laser, and Lockheed Martin Missiles & Space of Sunnyvale, California, is in charge of beam- and fire-control development.

Another key organization is the Air Force Research Laboratory's Directed Energy Directorate, also at Kirtland Air Force Base, New Mexico. For more than 20 years, the Laboratory has been conducting research into a myriad of technologies needed to make a defensive laser-carrying aircraft a reality. This includes the invention of the chemical laser that will be used on the YAL-1A and the development of technologies that will increase the distance laser light can travel through the atmosphere to destroy attacking missiles.



The \$1.3 billion award, which is also termed the Airborne Laser Program Definition and Risk Reduction contract, culminated a two-year concept definition phase in which Boeing competed with Rockwell International. Under contracts for \$22 million each, the two companies defined their concepts for a high-energy airborne laser system.

The most noticeable of the changes the aircraft is currently undertaking in Wichita is the installation of a turret in its nose from which a beam of laser light will emanate to destroy attacking missiles. Additionally, the aircraft will be modified to accept a multi-megawatt-class laser, specialized optics, and the computerized equipment that will allow the Attack Laser to spot its targets.

The Laser – Central to this system is the laser -- a chemical oxygen-iodine laser invented in 1977 by a predecessor unit of the Air Force Research Laboratory's Directed Energy Directorate.

This laser technology has some distinctive advantages. First, laser light is produced as a result of a chemical reaction – when oxygen and iodine chemistries are mixed. This means that the laser doesn't need a large electrical power plant to make it work as did the older, early-generation lasers. A second advantage is the laser's wavelength – an infrared (invisible) wavelength of 1.315 microns. That is the world's shortest wavelength for a high-power laser. This wavelength travels easily through the atmosphere and has greater brightness – or destructive potential – on the target.

Acquisition, Tracking & Pointing – Aside from needing a powerful laser, an airborne laser system must also be able to find and hit its targets. At the Army's White Sands Missile Range in southern New Mexico, tests were conducted in June of 1996, using a laser to illuminate and track a boosting rocket.

Atmospheric Experiments – Before an airborne weapon can become a reality, scientists needed to know more about what would happen to a laser beam traveling in a level (horizontal) path. What would the atmosphere do to that beam? A series of experiments, conducted in 1994 and the spring of 1995, provided those answers.

Experiments involved two airplanes flying at nearly 500 miles per hour, between 15 and 125 miles apart and at altitudes ranging from 35,000 to 50,000 feet. One aircraft was equipped with specialized instrumentation that received and measured a laser beam from the second plane and measured atmospheric turbulence in between.

Correcting For Atmospheric Turbulence – Correcting for those distortions was another tasking and the thrust of research for more than 15 years by another group of scientists at the Laboratory's Directed Energy Directorate and the Massachusetts Institute of Technology's Lincoln Laboratory. Working out of astronomical facilities at the Starfire Optical Range in the southeastern corner of Kirtland Air Force Base, researchers made revolutionary break-throughs using lasers, computers and deformable optics. Additional testing continues at the North Oscura Peak site in the northern portion of White Sands Missile Range. This testing is done at long ranges, under conditions that more closely reflected operational situations.

In this area, lasers and computers determine where the distortions are. The computers then manage deformable optics: a mirror whose face can be altered hundreds of times per second to help compensate for the distortions in the atmosphere. For the Attack Laser, this technology offers a way to increase the range of the laser beam through the air to destroy deadly theater ballistic missiles.

History – More than 15 years ago, the Air Force Research Laboratory and its predecessor units completed a project that showed the potential for an airborne laser. A tanker airplane was modified and equipped with a gas-dynamic laser. This aircraft shot down a low-flying drone and five air-to-air missiles. This series of experiments showed that the concept was possible.

Later tests were also conducted at White Sands Missile Range, aimed at finding out how effective a laser would be against Scud-like missiles. For these tests, the nation's most powerful laser, the Mid-Infrared Advanced Chemical Laser, was used. In every case, scale models of typical targets were easily destroyed.

The System – Computer simulations indicate that in actual battle, an airborne laser would be very effective. A fleet could arrive on the scene within hours, ready to take defensive positions. Two Attack Lasers would be flying around the clock, at about 40,000 feet. If the enemy were to launch a theater ballistic missile, the Attack Laser would detect the booster while it is still powered and emerges through the clouds. The Attack Laser would then destroy the missile, with the resulting debris tending to fall back on enemy territory.

The Space and Missile Systems Center, the Airborne Laser System Program Office's parent organization, develops and purchases military space systems, managing more than \$56 billion in contracts. The center has an annual operating budget of more than \$5.5 billion and employs about 3,400 people worldwide.



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